Causes of Non-Attainment

The previous methodology outlines the procedures for determining attainment of each designated beneficial use assigned to a waterbody. Causes of non-attainment must also be included in the State's Integrated Water Quality Assessment Report.

The causes and cause codes shown in Table 15 should be applied where applicable to each waterbody upon making a determination of non-attainment for any given designated beneficial use or subcategory of that use. Additional cause codes may be added to the State's Integrated Report in order to provide for numerical criteria in the State's Water Quality Standards not already represented with a cause code.

Sources of Non-Attainment

Sources are the activities, facilities, or conditions that contribute pollutants or stressors resulting in impairment of designated uses in a waterbody.

Determining the sources of designated use impairment can be a difficult process. Ambient monitoring data can give good evidence of the causes of impairment. In some cases, field observations can provide information on obvious, nearby problems; e.g., land use, substrate, and habitat may provide a basis for identifying sources. This is especially the case for "hydromodification" sources.

In most cases, additional information is needed – watershed land use inventories, records of permit compliance, locations of areas with highly erodible soils, areas with poor BMP (best management practice) implementation, measurements of in-place contaminants, or loadings from atmospheric transport or ground water.

For some waterbodies, potential non-point sources have been assigned to a cause using GIS data. Initially, an extensive list of potential sources for each cause is compiled. Geographical information such as the location of permitted activities (e.g., NPDES sources, CAFOs, oil & gas wells) and land use information (e.g., roads, pastures, cropland, municipal boundaries) is then compared to each watershed. Subsequently, potential sources not indicated by the geographic data are removed from the list of potential sources for a watershed. Potential sources not eliminated by the geographic information remain on the list as a potential source of impairment for waterbodies in the watershed.

This method of assigning potential sources has not been applied to all waterbodies and/or causes on the 2008 303(d) list. The intent is to use this methodology to assign potential sources to all 303(d) waterbodies for subsequent 303(d) lists.

A partial list of potential sources is shown in Table 16. Other source codes may be added as the need arises.

TABLE 15. CAUSE CODES

Cause	Cause Code
Ammonia (Unionized) - Toxin	91
Arsenic	96
Barium	104
Cadmium	127
Chloride	138
Chlorophyll-α	120
Chlorpyrifos	153
Chromium (total)	154
Color	160
Copper	163
DDT	214
Diazinon	187
Dieldrin	198
Enterococcus	215
Escherichia coli	217
Fishes Bioassessments (Streams)	230
Lead	267
Nitrates	302
Oil and Grease	317
Oxygen, Dissolved	322
Selenium	372
Sedimentation/Siltation	371
Silver	375
Sulfates	385
Total Coliform	398
Total Dissolved Solids	399
Toxaphene	496
Fecal Coliform	400
Turbidity	413
Zinc	423
pH	441
Phosphorus (Total)	462

TABLE 16. SOURCE CODES

Potential Source	Source Code
Acid Mine Drainage	2
Agriculture	156
Animal Feeding Operations (NPS)	4
Atmospheric Deposition – Acidity	8
CERCLA NPL (Superfund) Sites	16
Clean Sediments	21
Discharges from Biosolids (SLUDGE) Storage, Application or Disposal	33
Discharges from Municipal Separate Storm Sewer Systems (MS4)	34
Dredging (E.g. for Navigation Channels)	38
Grazing in Riparian or Shoreline Zones	46
Highway/Road/Bridge Runoff (Non-construction related)	49
Impacts from Land Application of Wastes	59
Impacts from Abandoned Mine Lands (Inactive)	56
Industrial Point Source Discharge	62
Land Application of Wastewater Biosolids (Non-agricultural)	68
Landfills	69
Leaking Underground Storage Tanks	70
Mine Tailings	82
Municipal (Urbanized High Density Area)	84
Municipal Point Source Discharges	85
Natural Sources	155
Non-irrigated Crop Production	87
On-site Treatment Systems (Septic Systems and Similar Decencentralized Systems)	92
Other Spill Related Impacts	97
Permitted Runoff from Confined Animal Feeding Operations (CAFOs)[1]	100
Petroleum/Natural Gas Production Activities (Legacy)	102
Rangeland Grazing	108
Releases from Waste Sites or Dumps	110
Residential Districts	111
Silviculture Harvesting	119
Spills from Trucks or Trains	124
Surface Mining	127
Source Unknown	140
Sources Outside State Jurisdiction or Borders	146
Total Retention Domestic Sewage Lagoons	128
Wastes from Pets	133
Wildlife Other than Waterfowl	136

TABLE 17. USEFUL INFORMATION IN DETERMINING SOURCES OF BENEFICIAL USE NON-ATTAINMENT

Source Category	Example Types of Information
Industrial Point Sources	Permit compliance records • analysis of DMRs • compliance monitoring or special monitoring in permits • WET or TIE bioassay tests Monitoring/modeling studies • upstream/downstream chemical, biological, and habitat monitoring • intensive surveys combined with WLA/TMDL modeling • complaint investigations • data from volunteer monitoring
Municipal Point Sources	Permit compliance records • analysis of routine DMRs • compliance monitoring or special monitoring in permits • WET or TIE toxicity bioassay tests Monitoring/modeling studies • upstream/downstream chemical, biological, and habitat monitoring • intensive surveys combined with WLA/TMDL modeling • complaint investigations • data from volunteer monitoring
Combined Sewer Overflows (CSOs)	Permit compliance records • records of nonachievement of targets for frequency of wet weather overflows • implementation of other minimum control and pollution prevention methods (as in EPA CSO Control Policy) Monitoring/modeling studies • upstream/downstream chemical, biological, or physical monitoring comparing wet weather and normal flow conditions • intensive surveys combined with WLA/TMDL modeling • complaint investigations
Agricultural Point Sources (e.g., CAFOs)	Permit compliance records • observation of overflows from total retention (non-discharge) facilities • compliance with provisions for off-site disposal of animal wastes (e.g., land application, composting) Monitoring studies • upstream/downstream chemical, biological, or physical monitoring (especially for nutrients and pathogens) • complaint investigations

Source Category	Example Types of Information
Agriculture (NPS)	Information from monitoring and field observations (e.g., to document bad actors) • edge of field monitoring of runoff from animal holding areas, cropped areas, or pastures • monitoring of inputs from irrigation return flows, sub-surface drains, or drainage ditches • proper installation of screens or other measures to avoid fish losses in drainage/irrigation ditches • serious rill or gully erosion in agricultural fields • sedimentation problems in agricultural watersheds • indications of unmanaged livestock in streamside management zones • complaint investigations or data from volunteer monitoring or inventories Records on watershed BMP implementation status • documented low implementation level (e.g., less than a 70% target) of recommended water quality BMPs • documented problems with specific agricultural operators Modeling • use of such models as AGNPS, SWAT or ANSWERS to estimate pollutant loads and improvement from BMP implementation • intensive surveys combined with WLA/TMDL modeling
Silviculture (NPS)	Monitoring and field observations documenting instances of high sediment delivery to receiving waters • BMPs not followed on logging road, skid paths, or stream crossings • BMPs not followed t o protect streamside management zones • serious sedimentation problems (cobble embeddedness or interstitial D.O. problems) in watersheds that are largely silvicultural Records on watershed BMP/management measure) • implementation status • documented low implementation level of recommended water quality-oriented BMPs Results of modeling or cumulative effects analyses • use of such models as WRENSS to estimate pollutant loads and likely improvement from BMP implementation • use of water temperature models t o help quantify impacts on cold water fisheries • use of landscape analysis techniques (e.g., the RAPID method or Integrated Riparian Area Evaluation method) to document cumulative effects • intensive surveys combined with WLA/ TMDL modeling
Construction	Information from monitoring and field observations (primarily to document problem areas or bad actors) • sedimentation problems documented in watersheds with major construction activity • complaint investigations and volunteer monitoring data Information from sediment control management agencies • records of implementation of sediment control measures

Source Category	Example Types of Information
Urban Runoff & Storm Sewers	Monitoring/modeling studies • upstream/downstream chemical, biological, or habitat monitoring comparing wet weather and normal flow conditions near outfalls • special monitoring for BMP effectiveness-wet ponds, artificial wetlands, grass swales • intensive surveys combined with WLA/ TMDL modeling and catchment models such as SWMM • complaint investigations Information from management agencies • documented low implementation level of recommended/required water quality-oriented BMPs • documented problems with BMP operation and maintenance information from monitoring and field observations (primarily to document problem areas or bad actors)
Resource Extraction (Petroleum)	Information from monitoring and field observations (primarily to document problem areas or bad actors) • evidence of oil and brine spills affecting areas near receiving waters; elevated TDS, toxicity, oil and grease aesthetic impacts; increased erosion and sedimentation problems • complaint investigations and volunteer monitoring data Information from petroleum management agencies monitoring data in streams, shallow wells, and springs in oilfield areas • records of problems with spills, pipeline breaks, over-topping of pit berms, land application violations
Resource Extraction (mainly surface mining)	Information from monitoring and field observations (primarily to document problem areas or bad actors) • evidence of decreases in pH, toxicity from heavy metals, excessive sedimentation, or stream reaches with iron bacteria in watersheds with active mining • complaint investigations and volunteer monitoring data Information from mining management agencies • records of recurrent permit violations (e.g., over-berming of settling ponds, failure to contain leachates, or failure to revegetate or restore mined areas)
Land Disposal	Monitoring and field observations (primarily to document problem areas or bad actors) • monitoring indicates leachate migration from disposal area or industrial or domestic leach field failures • complaint investigations and volunteer monitoring Modeling • solute transport or plume models (e.g., PRIZM) indicate high potential for pollutants to reach receiving water

Source Category	Example Types of Information
Hydromodification (dams, flow regulation)	Monitoring and field observations • recurring problems with inadequate instream flows (e.g., dewatering of streams, reduced pollutant assimilation, unnatural water temperatures) • documented interference with fish migration and spawning movements (e.g., for such anadromous fish as salmon or rockfish but also for inland fish that seek spawning habitat outside lakes or large rivers) Modeling • analysis using PHABSIM or other instream flow models to document adverse impacts • analysis related t o FERC permit renewal and State 401 Certification, habitat recovery plans under the ESA, or TMDL studies (e.g., problems with anoxic or nutrient-laden releases from hydrostructures)
Hydromodification (channelization, dredging, removal of riparian vegetation, streambank modification, draining/filling of wetlands)	Monitoring (usually over considerable period of time) documenting adverse changes: • severe channel downcutting or widening • elimination of vegetation in streamside management zones • excessive streambank erosion and sloughing • loss of significant wetland area in watershed • failure of wetland mitigation projects Modeling studies • decreases in pollutant assimilation from habitat modification • adverse impacts on hydrology, water temperatures, or habitat
Natural	Monitoring and field observations of the presence of sources that are clearly not anthropogenic • saline water due to natural mineral salt deposits • low DO or pH caused by poor aeration and natural organic materials • excessive siltation due to glacial deposits • high temperatures due to low flow conditions or drought Note: the Natural Sources category should be reserved for waterbodies impaired due to naturally occurring conditions

Prioritization of TMDL Development & Future Monitoring

After the final determination of beneficial use attainment is made, a four-level priority ranking for TMDL development will be established including waters targeted for TMDL development within the next two years (Priority 1). In accordance with EPA guidelines, priority determinations will take into account the severity of the impairments and the designated uses of the waters impacted. Waters in Category 5 (the State's 303(d) list) will be aggregated and prioritized according to their eleven digit hydrologic unit code (HUC11) watershed. The prioritization process will closely follow that used to develop the Unified Watershed Assessment except where changes are necessary due to programmatic and logistical differences between the two programs. Primary and secondary criteria were developed to evaluate and prioritize watersheds for TMDL development. The primary evaluation criteria used were the vulnerability of waters to degradation, the risks to public health and the threat to aquatic life.

A watershed's vulnerability for degradation was evaluated by first calculating the percentage of impaired waters for each HUC11 watershed based on the stream miles or equivalent stream miles (for lakes) listed as impaired divided by the total equivalent stream miles within the watershed. A Pollutant Priority Score was also developed and used based on a pairwise comparison matrix rank of all pollutant(s) and then calculating the mean of the values for those pollutants causing impairments within each watershed. The presence of protected waters or EQIP local emphasis areas were also used to evaluate watershed vulnerability.
The threat to public health was also considered in the prioritization by evaluating both the population served by Public Water Supplies (PWS) and number of PWS intakes in the watershed. In both cases the more population served and the higher the number of intakes the more weight given to the risks to public health.

In assessing of the threats to aquatic life within a watershed consideration was given to the presence of threatened or endangered species along with the area of waters of recreational and/or ecological significance listed in Appendix B of the Oklahoma Water Quality Standards. Calculating the percent change in wetland area for each HUC11 watershed along with the presence of priority wetlands designated by the United States Fish and Wildlife Service were also used to evaluate the threats to aquatic life.

The outline below summarizes both the primary and secondary criteria used to establish the TMDL priority for each HUC11 watershed.

1) **Vulnerability of waterbodies to degradation**
   a) Percent Stream Length/Lake Area Impaired
   b) Pollutant Priority Score (Pairwise pollutant comparison rating)
   c) Pristine Waters
      i) Scenic Rivers
      ii) Outstanding Resource Waters
      iii) High Quality Waters
      iv) Sensitive Water Supplies
   d) EQIP Local Emphasis Area
2) **Risks to public health**
   a) Public Water Supply Customers
   b) Public Water Supply Intakes
3) **Threat to aquatic life and other water-dependent wildlife**
   a) Presence of threatened and endangered species.
   b) Area of Waters of Recreational and/or Ecological Significance (Appendix B)
   c) Wetland Area
      i) Presence of USFWS Priority Wetlands
      ii) Change in Wetland Area

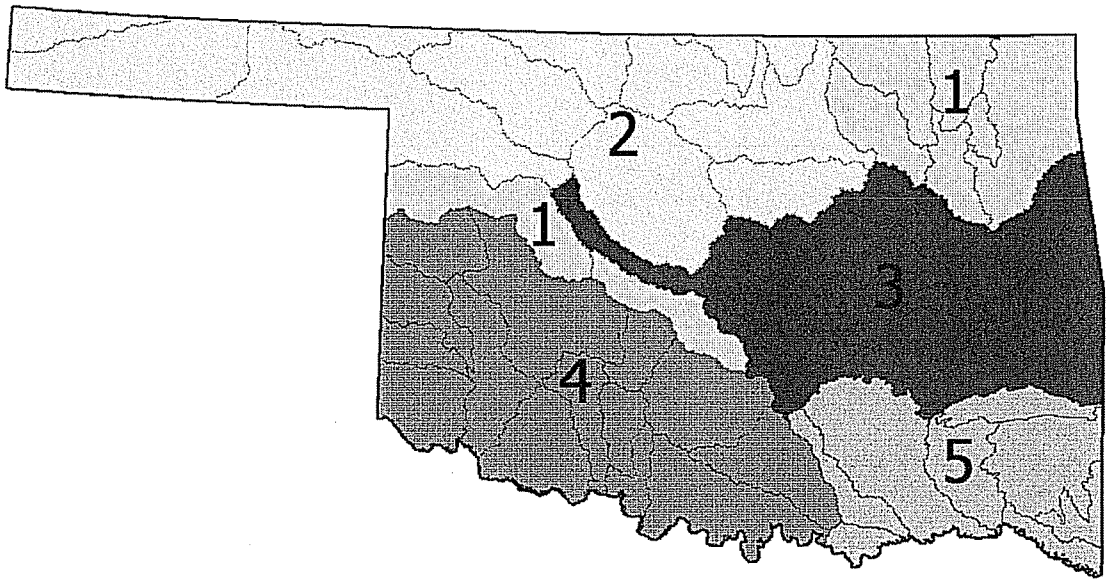
The priority ranking was established by giving each of the criteria above a ranking/points based on its overall importance. The criteria rankings or points were then totaled to give an overall score for each watershed. Table 16 below contains a more detailed summary of the actual weight given to each criterion.

TABLE 18. TMDL PRIORITIZATION-POINT RANKING

Points	Total Percent Impaired	Pollutant Priority Score	Wetland Percent Change	USFWS T&E Species	USFWS Wetland Priority	EQIP Local Emphasis Area	Highest Designated Protected Waterbody	Percent Appendix B Areas	PWS Intakes in HUC	PWS Customers Served
15	85	> 75th Quartile	>20%	≥ 3			Scenic R or ORW		≥ 4	≥ 100,000
10	65	Median to 75th Quartile	>10% to 20%	2			HQW		3	99,999 to 10,000
5	45	25th Quartile to Median	>5 to 10%	1	Yes	Yes	SWS	Upper 50th Percentile	2	9,999 to 1,000
3	25	< 25th Quartile	1 to 5%					Lower 50th Percentile	1	999 to 1
0	0	No Impairments	Gain or <1%		No	No		None	0	0

Where practicable, the State's Rotating Basin plan (Figure 5) will be used to schedule data collection projects in Category 2 & 3 waterbodies.

FIGURE 6. ROTATING BASIN PLAN WATERSHEDS BY YEAR



Coordination, Review, And Approval

The DEQ has coordinated the development and submittal of the Integrated Water Quality Report. The process began with a notice and request for input sent to EPA Region 6, state environmental agencies, and Tribal environmental offices. A series of interagency meetings were conducted to review the listing methodology, review and discuss the draft list along with priority rankings and scheduling, and facilitate the exchange of information. The draft list will be circulated to EPA Region 6 and state environmental agencies for comment prior to release for public participation.

Public participation will be undertaken in two phases. When the process to identify candidate waters began, nominations from the public were solicited. This involved distribution of the mailout shown in Figure 7 in September, 2007. Once the final draft list is compiled, it shall be submitted for formal public review with notice and a 30-day comment period. Upon the close of the comment period, a responsiveness summary will be prepared. DEQ will coordinate public participation activities. After the public review period and finalization of the list, it will be formally submitted to EPA Region 6 for review and approval.

FIGURE 7. MAILOUT REQUEST FOR PUBLIC INPUT

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How to Provide Input

The Department of Environmental Quality invites you to provide water quality information to be considered in Oklahoma's Integrated Report. All information must be submitted either in writing or by E-mail before the end of the solicitation period. A summary of our decisions regarding the submitted information will be included in the final integrated report submitted to EPA Region 6.

Information should be directed to:
Elena Jigoulina
Water Quality Division
Department of Environmental Quality
P.O. Box 1677
Oklahoma City, Oklahoma 73101

Information can also be submitted via E-mail to:
elena.jigoulina@deq.state.ok.us

In order to be considered, all nominations must be received before 5:00 P.M. on Friday, October 19th.

To Obtain More Information

Copies of the state's *Continuing Planning Process* and most recent 303(d) list (2004 Integrated Report, Category 5), and 2006 draft report are available for downloading at:

http://www.deq.state.ok.us/WQDnew/index.htm

Copies of the Use Support Assessment Protocols and the most recent *Oklahoma's Water Quality Standards* are available for downloading at:

http://www.owrb.state.ok.us/util/rules/rules.php

DEPARTMENT OF ENVIRONMENTAL QUALITY
P.O. Box 1677
OKLAHOMA CITY, OKLAHOMA 73101

Oklahoma's
Integrated Water Quality Monitoring and Assessment Report
Including the 303(d) List of Impaired Waterbodies
2008

Public Solicitation for
Water Quality Information
September 19th, 2007

Sponsored By:

OKLAHOMA
DEPARTMENT OF ENVIRONMENTAL QUALITY

Water Quality Division

P.O. BOX 1677

Oklahoma City, Oklahoma 73101-1677

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BACKGROUND
The State of Oklahoma is in the process of developing the 2008 Integrated Water Quality Monitoring and Assessment Report. The Integrated Report will include the 303(d) list. This list is used to establish priorities for water quality improvement measures, including development of total maximum daily loads (TMDLs) which are water quality planning documents that establish specific goals for water quality conditions.

This solicitation notice serves as a means of gaining information about water quality from the public. Once the final draft report is compiled, a formal public review and 30-day comment period, culminating with a formal public meeting, will complete the second phase of public participation.

According to section 303(d)(1) of the Clean Water Act, states are to identify waters that do not meet water quality standards, even after technology-based controls required by the Act, and any other controls required by state or local authority, are in place. These waters are called "water quality-limited" and may require the development of a TMDL in order to establish additional controls or management measures necessary to achieve water quality standards.

Federal regulations governing the 303(d) listing process and TMDL development are found at 40 CFR Part 130. The US Environmental Protection Agency (EPA) provided guidance to the states for developing Integrated Reports (USEPA, 2006). The EPA emphasized that the Integrated Report guidance does not alter the statutory provisions in sections 305b and 303d of the Federal Clean Water Act, nor does it change existing rules governing development of Impaired Waterbodies Lists discussed above.

Oklahoma's process for developing/revising its Integrated Report is contained in the State's *Continuing Planning Process* ("CPP") document. [http://www.deq.state.ok.us/wqdnew/pubs/2006_CPP_final.pdf]

SUBMITTING WATER QUALITY INFORMATION
The Water Quality Planning and Management regulations (40 CFR 130.7) require that "all existing and readily available water quality related data and information" must be evaluated in developing the 303(d) list. A complete list of criteria and information necessary for consideration is found in the CPP.

In general, water quality data must meet the following criteria to be considered:

- Ambient data no greater than five years old that indicates attainment status of water quality criteria related to designated uses.
- Only data collected before April 30, 2007 should be used in use attainment determinations.
- Impairments must be due to specific pollutants that are conducive to the TMDL process, and the specific source causing impairment must be noted in the submittal, if known.

All nominations must include the following information:

✓ ***Waterbody Identification***
Oklahoma currently uses a 14-digit waterbody identification ("WBID#") system. If you do not know the appropriate WBID# for your particular segment, you can provide an accurate legal description or latitude/longitude reference for your segment of concern. In addition, please supply the common name for the waterbody as it is listed on a United States Geological Survey (USGS) topographical map.

✓ ***Justification for Listing Decision***
It is imperative that all attainment decisions are based on ample data and documentation to prove that water quality standards are impaired or not. Your submittal should include a summary of the data used to support the decision, the complete data set (or reference to the complete data set if it is contained in a published report), and an analysis showing water quality standards violation or attainment. *Oklahoma's Water Quality Standards, Use Support Assessment Protocols,* and the *Integrated Water Quality Report Listing Methodology* procedures in the CPP should be consulted and utilized in your justification and analysis.

✓ ***QA/QC Procedures Used***
Data submitted should include information on sampling and analyses, including Quality Assurance and Quality Control (QA/QC) procedures used. DEQ will evaluate the QA/QC protocols used in gathering and analyzing the samples to decide if and how that data will be used. To be used, data must use QA/QC methods that are in accordance with "EPA Requirements for QA Project Plans" (QA/R5, May 2001).

Groundwater Quality

Overview

Groundwater is an important natural resource in Oklahoma. There are twenty-one major groundwater basins in the state and approximately 150 minor basins. These major basins are used as primary source of community drinking water and are estimated to hold over 320 million acre-feet of fresh water. See Figure 8 for a detailed map of the "Major Groundwater Aquifers in Oklahoma".

The Oklahoma CAFO Act puts measures into place that prohibit a hydrologic connection between generated wastewater and waters of the state. The Act further states that samples of water from Licensed Managed Feeding Operations (LMFO) monitoring wells located around swine lagoons shall be collected by the ODAFF and tested at least annually. Licensed Managed Feeding Operations (LMFO's) licensed on or after August 1, 1998 had to install a monitoring "system" (leak detection or wells) before using the retention structure to store liquid wastes. The main goal of the monitoring program is to ascertain if groundwater resources at or near the LMFO's are being subject to any degradation as result of the operation of the facilities and storage of the liquid animal waste. The baseline data for the facilities serves as a reference point to potential change in groundwater quality over time. Beginning in the Fall of 1999 to present date, the Department has been involved with the annual sampling and evaluation of over 1,000 monitoring wells at swine LMFOs as required by provisions in the Act.

There are extensive produced water/brine groundwater plumes in some old oilfield areas due mainly to old spills that were never remediated, leaking unplugged wells, and to the former practice (now banned for over thirty five years) of dumping produced brines into "evaporation pits". Pollutants and saline water have migrated from these surface and subsurface sources into underlying soils and groundwater. Drinking water wells in the some areas have been rendered un-usable, and many streams are now being impacted by saline groundwater plumes that emanate from the old produced water and "evaporation pit" areas. Counties where this has been identified as a known or likely problem include Pottawatomie, Seminole, Kay, Oklahoma, Carter, Garvin, Garfield, and Stephens. Other areas have yet to be investigated.

Since 1996 the Corporation Commission has collected approximately 2500 groundwater samples near known and suspected oil and gas spill sites and/or in response to complaints from citizens in oil and gas field areas. These are taken in domestic water wells; in monitoring wells installed to investigate possible groundwater pollution; from water seeping into borings and dug trenches; and from springs and seeps where groundwater emerges at the surface. Samples are analyzed for TDS, chlorides, and sulfates , petroleum, metals, or other parameters as appropriate, in order to determine what actions are needed in each case. Corp Comm has also begun to list significantly impacted groundwater pollution sites in the OWRB's Appendix H, where the public and water well drillers can be apprised of areas where standard water well installation is inappropriate.

Corp Comm is also attempting to utilize this data in conjunction with surface water data to determine potential sources of watershed impairments and/or areas in which corrective action should be taken. For example, many of the salinity impacted streams found to date have no apparent surface source. However, ground water and spring/seep samples taken near some of these streams show that there is an adjacent subsurface brine plume, probably the source for the stream's excess salinity. If the source for each brine plume could be determined and remediated, the plume(s) could no longer carry pollutants to the streams and cause stream impairments. Corp Comm is using its current ground water sampling data for this purpose in a few areas, but does not yet have the funding to undertake extensive sampling near impaired streams to determine the potential groundwater sources for all impaired streams. Corp Comm is also beginning to obtain GPS locations on all oil and gas wells in the state in order to be able to accurately map well distribution and predict possible impacts.

In addition to groundwater sampling, Corp Comm funded a USGS test of a Helicopter borne Electro-Mag (HEM) tool in 25 (twenty-five) square miles in Carter and Stephens counties near salinity impaired streams. HEM can rapidly cover large areas to determine groundwater impairments and surface water/groundwater interaction. Saline polluted groundwater plumes in aquifers, some of which are flowing into and impairing streams in the study area, are now being mapped. Source location is the next step. In addition, Corp Comm is also trying to obtain grant funding to extend this HEM project to the other thousands of square miles of old oilfield areas in the state, in order to determine which if any also have impacted groundwater.

In 1984, the OWRB established a monitoring network to determine the ambient quality of major aquifers for the development of numeric groundwater quality standards. Between 1984 and 1992, the OWRB collected annual samples from a network of more than 200 domestic, irrigation, stock, and municipal water wells. Samples were analyzed for major ions and metals. Unfortunately, this program was discontinued after nine years of data collection due to lack of funding. However, the OWRB continues to conduct sampling of major aquifers as part of their basin studies and Beneficial Use Monitoring Program (BUMP). For example, in 2001 the OWRB sampled 61 wells in the Cimarron Alluvium and Terrace aquifer for nutrients and major ions. In 2002, 64 wells in the North Fork of the Red River Alluvium and Terrace aquifer were sampled for major ions.

The OWRB has also conducted statewide monitoring of groundwater *quantity* since 1937 through the mass measurement program, in which water levels in more than 585 wells are measured annually to assess long-term trends in groundwater levels and aquifer storage.

OWRB contracts with Oklahoma Department of Agriculture (with the assistance of an EPA grant) to perform compliance groundwater monitoring at swine Licensed Managed Feeding Operations and the number of observation wells in the annual water level measurement program is approximately 500 beginning 2008.

The DEQ has two monitoring programs that address groundwater: the Public Water Supply Compliance Sampling and a 106 Ambient Groundwater Monitoring program. Public water supplies must collect samples at various intervals and locations to determine if the water they serve the public complies with primary drinking water standards as set forth in the Safe Drinking Water Act. Most of these samples are collected at points of entry into the distribution system. The water entering the system at the points of entry can represent one or several groundwater sources. This data is compiled and used to determine areas of contamination and to set expected concentration ranges of various chemical contaminants. Historic data has been compiled going back to the 1920's and future data can be compared to historic ranges to determine changes over time. Intentions are to identify potential concerns before they become major problems.

The DEQ's 106 Groundwater Monitoring Program will use public water supply operators to collect samples from 420 randomly selected PWS wells annually. Samples will be analyzed for secondary drinking water parameters and major ions. Data will be used to evaluate and classify groundwater quality and determine aquifer homogeneity. The three years of monitoring data, analyzed, verified, and compiled are available to State agencies, federal agencies, and the citizens of Oklahoma for their use. This information will be available on the Oklahoma Department of Environmental Quality's website at http://www.deq.state.ok.us/WQDnew/groundwater/index.html. Maps of water quality are included here for nitrates, sulfates, and total dissolved solids in the major aquifers. Trends established by this ambient monitoring program can be used to identify sources of polluted runoff that potentially could adversely impact vulnerable groundwater resources.

The DEQ has several remediation programs that identify, monitor, and when needed, remediate local sources of ground water pollution from releases at regulated facilities, historical releases, and spills. Most of these sources are very localized and are not included as areas with problems or concerns.

Major Aquifers with Anthropogenic Water Quality Problems or Concerns

Major aquifers are defined as aquifers which can effectively yield 150 gallons per minute or greater. The following information is based on samples submitted to The DEQ of domestic wells and through the PWS program. This information is based upon the most recent information provided to this division as of December of 2002. For location of the major groundwater aquifers of Oklahoma, please refer to Figure 7.

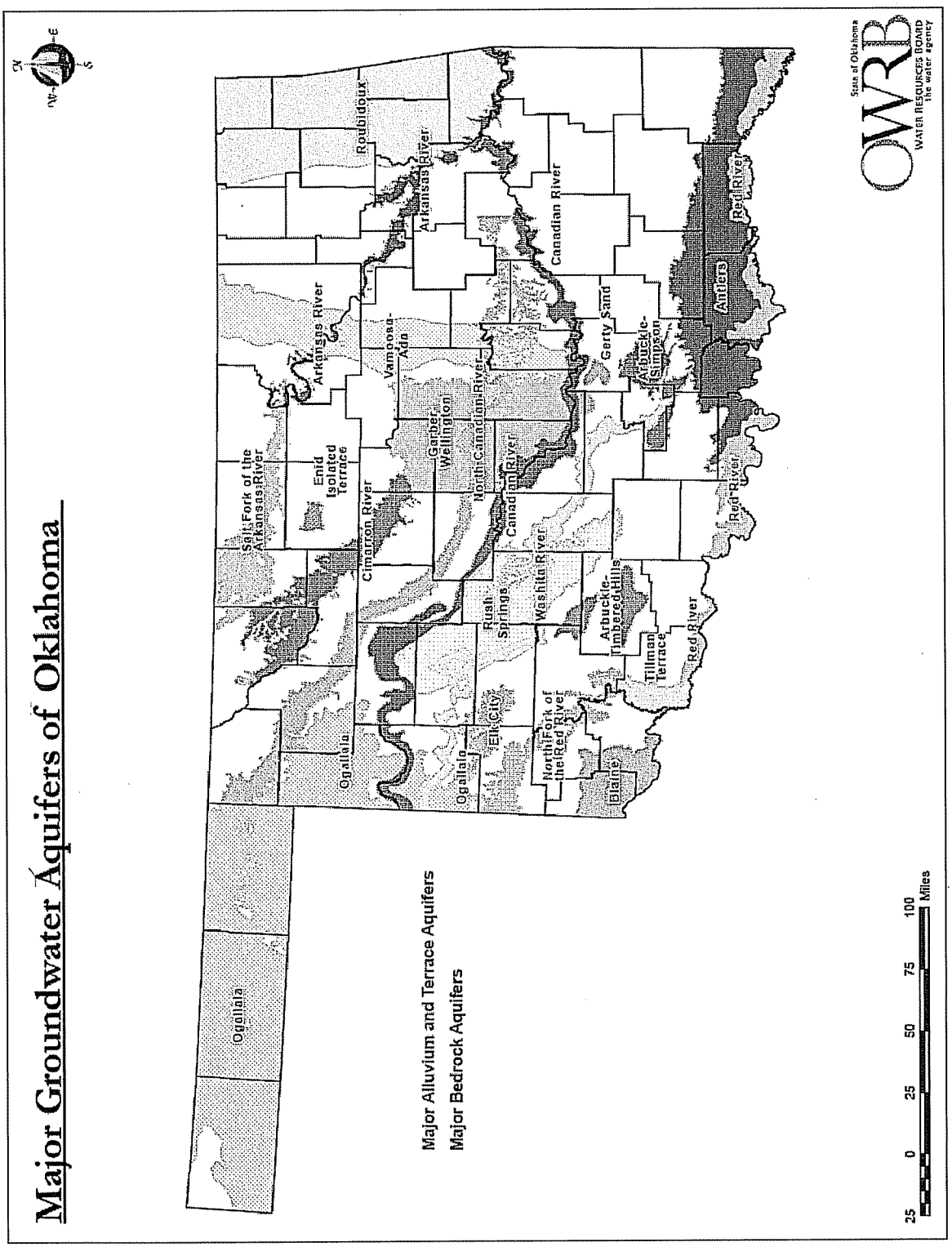
Alluvium and Terrace Deposits of the Salt Fork of the Arkansas River

The DEQ has identified several wells and well fields in this aquifer with elevated nitrate levels.

Alluvium and Terrace Deposits of the Arkansas River

The DEQ has identified several wells and well fields in this aquifer with elevated nitrate levels.

FIGURE 8. GROUNDWATER AQUIFERS OF OKLAHOMA



Alluvium and Terrace Deposits of the Enid Isolated Terrace Deposits

The DEQ has identified a well in this aquifer with elevated nitrate levels.

Alluvium and Terrace Deposits of the Cimarron River

The DEQ has identified several wells and well fields in this aquifer with elevated nitrate levels.

Alluvium and Terrace Deposits of the Beaver-North Canadian River

The DEQ has identified several wells and well fields in this aquifer with elevated nitrate levels.

Alluvium and Terrace Deposits of the Canadian River

The DEQ has identified several wells and well fields in this aquifer with elevated nitrate levels.

Alluvium and Terrace Deposits of the Washita River

The DEQ has identified a well field in this aquifer with elevated nitrate levels.

Alluvium and Terrace Deposits of the North Fork of the Red River

The DEQ has identified several wells and well fields in this aquifer with elevated nitrate levels.

Alluvium and Terrace Deposits of the Red River

The DEQ has identified several wells and well fields in this aquifer with elevated nitrate levels.

Ogallala Formation

The DEQ has identified a well field in this aquifer with elevated nitrate levels. Some of the wells showed elevated levels of selenium, probably of natural origin.

Antlers Sandstone

The DEQ has identified several monitoring wells in this aquifer with elevated nitrate levels. Some of the wells showed consistently low pH values.

Rush Springs Sandstone

The DEQ has identified several wells, monitoring wells and well fields in this aquifer with elevated nitrate levels and a well field with hydrocarbon and chloride contaminations. The contamination is the result of historic oil and gas activities (extraction, refinement, and salt-water disposal).

Garber Sandstone and Wellington Formation

The DEQ has identified several wells in this aquifer with gross alpha activity above the maximum allowable limit of 15 pCi/L. The Department has also identified several wells and well fields with selenium contamination. Localized wells and monitoring wells have been identified with industrial solvent contamination. Several wells have been detected with elevated levels of nitrates and chlorides. Arsenic is naturally occurring within this aquifer and several excursions above the new MCL of 10 g/L have been noted via DEQ source monitoring actions.

Roubidoux Formation

The DEQ has identified several newly installed wells in this aquifer that show local elevated iron, sulfate, and total dissolved solid levels in Ottawa County attributed to mine water contamination from historical mining from the Tar Creek Superfund site. The intervening Boone Formation is heavily impacted by the mining and is the source for localized problems within the Roubidoux. DEQ and EPA continue to monitor water quality in this area under the After Action Monitoring Program.

Vamoosa Formation

The DEQ has identified several wells in this aquifer with elevated fluoride levels. The DEQ, the OWRB, and the United States Geological Survey have identified several wells and well fields with chloride contamination.

The Arbuckle Formation

The DEQ has identified several monitoring wells in this aquifer with elevated fluoride levels and a tendency towards excessive hardness. There are no known groundwater based community public drinking water systems experiencing water quality problems. The source appears to be natural and has therefore limited the usefulness of this formation as a drinking water source.

Non-major Aquifers with Anthropogenic Water Quality Problems or Concerns

Non-major aquifers are defined as aquifers which effectively yield less than 150 gallons per minute. The following information is based primarily on individual wells or well fields that were affected by problems. These wells may or may not constitute a public water supply. In most cases, the problem wells are not in use, or have had their water blended with other sources to reduce the contaminant(s) to acceptable level(s). For location of the major aquifers, please refer to the maps "Alluvium and Terrace Deposits in Oklahoma" and "Major Bedrock Aquifers in Oklahoma".

The Boone Formation/Boone Chert/Keokuk and Reeds Springs Formation

The DEQ and the OWRB have identified several monitoring wells in this aquifer at the Tar Creek Superfund site in Ottawa County with low pH levels and heavy metal contamination. The source of contamination is from historic mining operations. This formation overlays the Roubidoux Formation. The Roubidoux Formation is threatened and locally impacted near several monitoring wells due to the severity of the contamination in the overlaying formations.

The Oscar "A" Formation

The DEQ has identified several wells in this aquifer with elevated nitrate levels and gross alpha activity above the maximum allowable limit of 15 pCi/L. These concerns are similar to those expressed for the Garber/Wellington Formation.

McAlester and Hartshorne Formation-Savanna Formation/McAlester Formation/Hartshorne Sandstone Formation

The DEQ has identified several monitoring wells in this aquifer with low pH levels, heavy metal contamination, chlorides, and some controlled industrial wastes. The source of contamination is from historic mining operations and off-site disposal pits for oil field and industrial waste.

Walnut Creek Alluvium Deposits

The DEQ has identified two well fields in this aquifer with elevated nitrate levels.

Tillman Terrace Deposits

The DEQ has identified two well fields in this aquifer with elevated nitrate levels and elevated levels of selenium.

Little Sandy Creek Alluvium Deposits

The DEQ has identified a well field in this aquifer with elevated nitrate levels.

West Cache Creek Terrace

The DEQ has identified a well field in this aquifer with elevated nitrate levels.

Major Sources of Contamination

The major sources of contamination within the state are listed in Table 19. The basis used for establishing the priority ranking system was based upon information collected from the various monitoring programs (e.g. the monitoring network, the ambient monitoring program and the wellhead protection program and the Tar Creek After-Action Monitoring Program).

TABLE 19. MAJOR SOURCES OF CONTAMINATION

Contaminant Sources	Highest Priority Sources	Factors Considered in Selecting a Contaminant Source[1]	Contaminants[2]
Agricultural Activities			
Agricultural Chemical Facilities			
Animal Feedlots	√	A - C - D - E	E - J
Drainage Wells			
Fertilizer Applications	√	C - E	E
Irrigation Practices	√	C - E	E
Pesticide Applications			
Storage and Treatment Activities			
Land Application	√	C - D - E	D - E - H - J - L
Material Stockpiles			
Storage Tanks (Above Ground)			
Storage Tanks (Underground)	√	A - C - E	D
Surface Impoundments	√	A - C - D - E	D - E - G - H - J - L
Waste Piles	√	C - D	H
Waste Tailings	√	C - D	H
Disposal Activities			
Deep Injection Wells	√	C - D - E	C - D - G - H
Landfills			
Septic Systems	√	A - C - D - E	E - J - L
Shallow Injection Wells			
Other			
Hazardous Waste Generators			
Hazardous Waste Sites			
Industrial Facilities			
Material Transfer Operations			
Mining and Mine Drainage	√	A – C – D - E	H
Pipelines and Sewer Lines			
Salt Storage and Road Salting			
Salt Water Intrusion	√	C - D - E	G - D
Spills		D	D - G
Transportation of Materials		D	D
Urban Runoff			
Other Sources Abandon Wells (Unplugged)	√	A - C - D - E	A - B - D - E - G - J - L - M

KEY TO TABLE 18

1	2
A. Human health and/or environmental risk (toxicity)	A. Inorganic Pesticides
B. Size of the population at risk	B. Organic Pesticides
C. Location of the sources relative to drinking water sources	C. Halogenated Solvents
D. Number and/or size of contaminant sources	D. Petroleum Compounds
E. Hydrogeologic sensitivity	E. Nitrate
F. State findings, other findings	F. Fluoride
G. Other	G. Salinity/Brine
	H. Metals
	I. Radionuclides
	J. Bacteria
	K. Protozoa
	L. Viruses
	M. Any Unlisted Surface Contaminants

Overview of State Groundwater Protection Programs

Table 20 contains a summary of the state groundwater protection programs.

The DEQ received authority under HB 2227 and 1002 and S. B. 361 (clean up bill for HB 1002) to be the lead agency for Oklahoma's Wellhead Protection Program. Due to the variety of potential causes and sources of groundwater contamination, other state environmental agencies are involved in this program. These include the ODAFF, OWRB, OCC, Corporation Commission, Wildlife Department, and the Department of Mines.

TABLE 20. SUMMARY OF THE STATE GROUNDWATER PROTECTION PROGRAMS

Program or Activities	Check if active	Implementation Status	Responsible Agency
Active SARA Title III Program	√	FE	DEQ
Ambient groundwater monitoring system	√	CE	DEQ
Aquifer vulnerability assessment	√	FE	DEQ*
Aquifer mapping	√	CE	OWRB*
Aquifer characterization	√	CE	OWRB*
Comprehensive data management system	√	CE	DEQ
EPA - endorsed Core Comprehensive State Groundwater Protection Program (CSGWPP)	√	CE	DEQ*
Groundwater discharge permits	√	FE	DEQ*
Groundwater Best Management Practices	√	CE - UR	DEQ*
Groundwater legislation	√	CE	OWRB*
Groundwater classification	√	CE	OWRB*
Groundwater quality standards	√	CE	OWRB*
Interagency coordination for groundwater protection initiatives	√	CE	OSE*
Nonpoint source controls	√	UD	OCC*
Pesticides State Management Plan	√	FE	ODAFF
Pollution Prevention Program	√	FE	DEQ

Program or Activities	Check if active	Implementation Status	Responsible Agency
Resource Conservation and Recovery Act (RCRA) Primacy	√	FE	DEQ
Source Water Assessment and Protection Program (SWAP)	√	FE	DEQ
State Superfund	√	CE	DEQ
State RCRA Program incorporating more stringent requirements than RCRA Primacy	√	CE	DEQ
State septic system regulations	√	FE	DEQ
Underground storage tank installation requirements	√	FE	Corp. Comm
Underground Storage Tank Remediation Fund	√	FE	Corp. Comm
Underground Storage Tank Permit Program	√	FE	Corp. Comm
Oil & Gas well drilling, commercial mud pit, and land application permit programs	√	FE	Corp. Comm.
Special protective rules for pit liners and O&G well casing when close to water wells	√	FE	Corp. Comm.
Oil & Gas injection well UIC Program	√	FE	Corp. Comm.
Oil & Gas state abandoned well plugging fund program	√	FE	Corp. Comm.
Oil & Gas surface and groundwater assessment and remediation oversight programs	√	FE	Corp. Comm.
Oil & Gas orphaned and abandoned well site cleanup program (state authorized industry funded)	√	FE	OERB
Oil & Gas base of fresh/treatable water mapping program	√	CE	Corp. Comm.
Underground Injection Control Program	√	FE	DEQ*
Vulnerability assessment for drinking water / wellhead protection	√	CE	DEQ
Well abandonment regulations	√	FE	OWRB*
Wellhead Protection Program (EPA - approved)	√	CE - FE	DEQ
Well installation regulations	√	FE	OWRB*

KEY TO TABLE 19

Implementation Status		Responsible Agency	
CE	Continuing Efforts	DEQ	Oklahoma Dept. of Environmental Quality
FE	Fully Established	OCC	Oklahoma Conservation Commission
NA	Not Applicable	Corp Comm	Oklahoma Corporation Commission
P	Pending	OWRB	Oklahoma Water Resources Board
UD	Under Development	OSE	Office of the Secretary of Environment
UR	Under Revision	OERB	Oklahoma Energy Resources Board
		ODAFF	Oklahoma Dept. of Agriculture Food and Forestry

Oklahoma's Wellhead Protection Program

The DEQ developed its Wellhead Protection Program in accordance with the EPA guidelines set forth under the Safe Drinking Water Act ' 1428 (as amended in 1986). Oklahoma's Wellhead Protection Program is a mechanism to assist local communities in protecting their groundwater based drinking supplies. The goal of the Wellhead Protection Program is to delineate protected areas around a drinking water wellhead. In these protected areas, potential causes and sources of groundwater contamination can be identified and managed thus reducing or eliminating the risk of well contamination.

Under Oklahoma's Wellhead Protection Program, managers of groundwater based drinking water systems may contact the DEQ to request technical assistance. The state will also offer technical assistance for such tasks as evaluating the potential for groundwater contamination, determining possible sources of contamination, proposing model ordinances for control of potential sources of contamination, and/or preparing a contingency plan in the event of well contamination. The program advocates land use restrictions around the wellhead. At present, emphasis is placed on the development of contingency plans, educational programs and voluntary implementation of best management practices to reduce or eliminate the need for restrictive regulatory protection.

Groundwater Indicators

The DEQ routinely monitors public drinking water wells for nitrates, coliform bacteria, volatile organic compounds and other drinking water quality parameters. The DEQ has regulatory authority for public water supplies under 63 O.S. 1981, ' 1-901 *et seq*. The regulations were last amended by the Oklahoma State Board of Health on February 8, 1990 (effective May 25, 1990) and incorporated into the DEQ on January 1, 1993 (effective July 1, 1993 and amended July 1, 2003). Table 20 lists the various supply systems with standards violations. With the exception of nitrate as nitrogen, most of the contaminants are of natural origin. Note that in the "Date Violation Confirmed" column, some violations are of recent discovery and others have been known for several years.

TABLE 21. PUBLIC WATER SUPPLY STANDARDS VIOLATIONS

System Name	County	Aquifer	Date Violation Confirmed	Current Level (mg/L)	Date of Last Analysis
Nitrate, Maximum Allowable Limit – 10 mg/L (ppm)					
Aline	Alfalfa	Cimarron Terrace	2000	13	11/2/2007
Canadian Co RWD # 1	Canadian	North Canadian River Alluvium	1994	14	9/25/2007
Carmen	Alfalfa	Cimarron Terrace	1995	11	10/15/2007
Cimarron City	Logan	Cimarron Alluvium	2005	11	12/6/2006
Cleo Springs	Major	Cimarron Terrace	1993	11	4/16/2007
Deer Creek	Grant	Arkansas River, Salt Fork Alluvium	1993	11	9/14/2007
Garfield Co RWD # 5	Garfield	Cimarron Terrace - Cedar HL	1994	14	8/2/2007
Garfield Co RWD #1 (KREM-HILL)	Garfield	Enid Terrace	1993	11	6/6/2006
Goltry	Alfalfa	Turkey Creek Alluvium	1993	15	10/28/2007
Hollis	Harmon	Red River, Salt Fork Terrace	1993	12	9/14/2007
Hydro PWA	Caddo	Rush Springs Sandstone	1995	12	6/6/2006
Laverne	Harper	North Canadian River Terrace	2005	11	9/14/2007
Logan Co RWD #2	Logan	Cimarron River Terrace	1993	15	10/2/2007
Loyal	Kingfisher	North Canadian River Alluvium	1998	12	6/4/2007
Major Co RWD #1	Major	Cimarron Terrace	1996	11	4/18/2007

System Name	County	Aquifer	Date Violation Confirmed	Current Level (mg/L)	Date of Last Analysis
Mooreland	Woodward	North Canadian River Terrace	1993	11	10/16/2007
North Blaine Water	Blaine	North Canadian River Alluvium	1993	14	7/11/2007
North Blaine Water	Blaine	Cimarron River Terrace	1993	14	7/11/2007
Okarche	Kingfisher	North Canadian River Alluvium	2001	12	9/14/2007
Okarche RWD	Kingfisher	North Canadian River Alluvium	1988	14	11/2/2007
Payne Co RWD #3	Payne	Stillwater Creek Alluvium	1990	13	11/2/2007
Payne Co RWD #3	Payne	Vamoosa	1990	13	11/2/2007
Raintree Addition	Osage	Arkansas River Alluvium	2000	12	10/15/2007
Southern Hills Inc	Stephens	Unknown	2007	20.5	9/14/2007
Thirsty Water Corp.	Greer	Red River, North Fork Terrace	2005	11	9/14/2007
Timberline MHP	Osage	Arkansas River Alluvium	1993	23	10/2/2007
Tuttle	Grady	Unknown	2000	12	10/5/2007
Apex Fitness	Grady	Unknown	2006	12	11/2/2006
Big Belly Bar B Que	Cleveland	Unknown	2004	11	6/6/2006
Cummins Pontiac	Custer	Unknown	2005	17	7/23/2007
IBS Pizza and Deli Convenience Store	Logan	Unknown	2005	20	10/2/2007
Mycoland RV & Mobile Home Park	Osage	Arkansas River Alluvium	1993	11	7/21/2006
Syms Stop & Shop	Woodward	Unknown	2007	11	11/2/2007
Arsenic, Maximum Allowable Limit – 0.010 mg/L (ppm)					
Cedar Ridge Estates Development Co	Logan	Unknown	2007	0.027	9/14/2007
Applewood MHP	Oklahoma	Garber-Wellington	1985	0.061	12/18/2007
Edmond PWA – Arcadia	Oklahoma	Garber-Wellington	2007	0.023	11/6/2007
Corn PWA	Washita	Rush Springs Sandstone	2007	0.008	1/6/2006
Cadmium, Maximum Allowable Limit – 0.005 mg/L (ppm)					
Falconhead Property Owners Association	Love	Antlers Sand	2006	0.008	1/6/2006
Fluoride, Maximum Allowable Limit – 4.0 mg/L (ppm)					
Three Springs Farm	Cherokee	Unknown	2005	5.2	5/18/2006
Tetrachloroethylene, Maximum Allowable Limit – 0.005 mg/L (ppm)					
Highpoint MHP	Garfield	Enid Terrace	2006	0.013	11/28/2006

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Appendix A

Oklahoma Waterbody Identification (WBID) System

Waterbody identification (WBID) numbers are established based on a waterbody's location in the State's Water Quality Management Plan. WBIDs are unique identifiers that offer a convenient, unambiguous method of referencing waterbodies within the State of Oklahoma. A complete WBID consists of a two-letter, fourteen-digit identifier.

Example: **OK311500030010_00 -** Elk Creek in southwest Oklahoma

The first two characters define the state code as required by EPA.

"OK ...._.."

The next six digits are derived from Oklahoma's Water Quality Management Planning Basins. The State's seven large, one-digit planning basins are broken down into smaller basins, each identified with a six-digit number.

"OK 311500 .. ...._.."

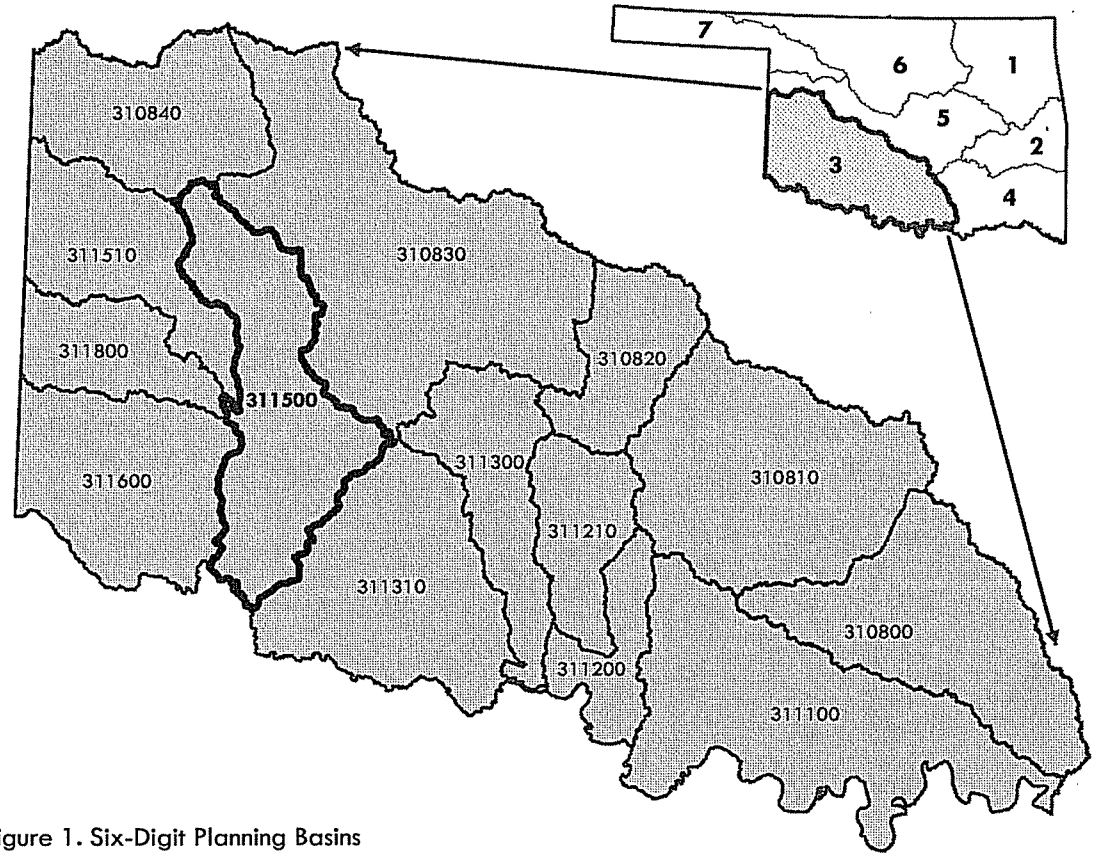


Figure 1. Six-Digit Planning Basins

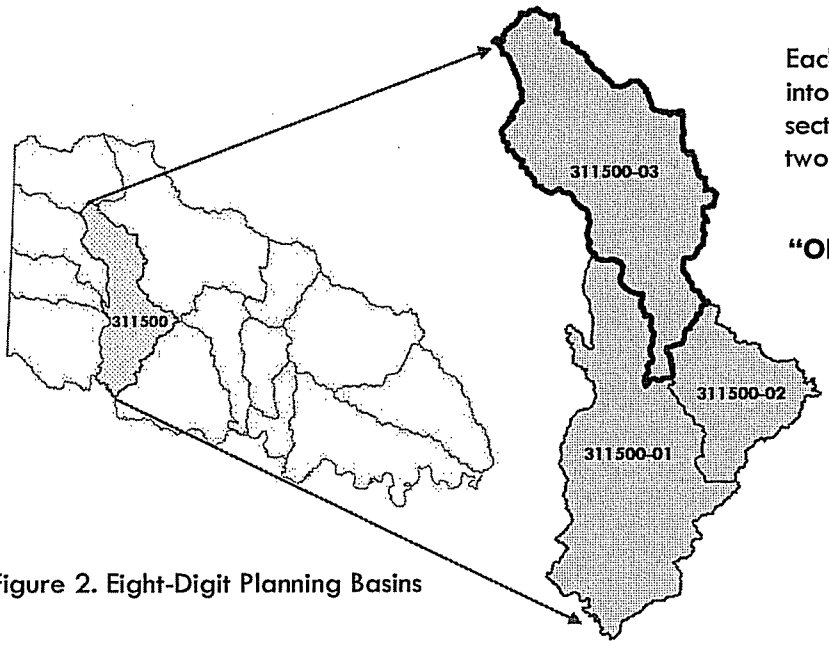


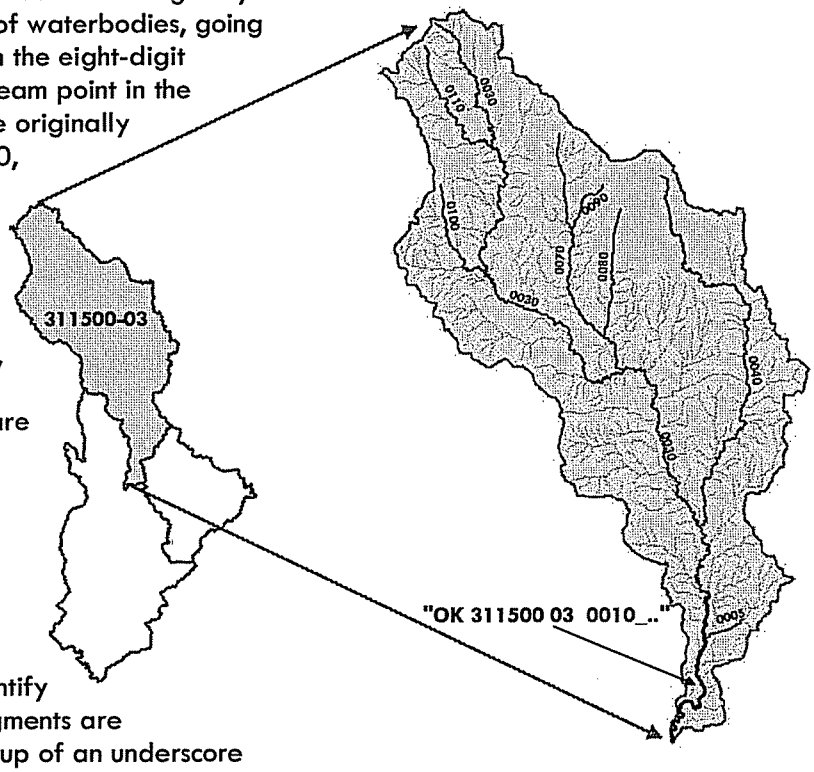
Figure 2. Eight-Digit Planning Basins

Each six-digit basin is divided into a number of smaller sections that are identified by a two-digit number (Figure 2).

"OK 311500 03 ...._.."

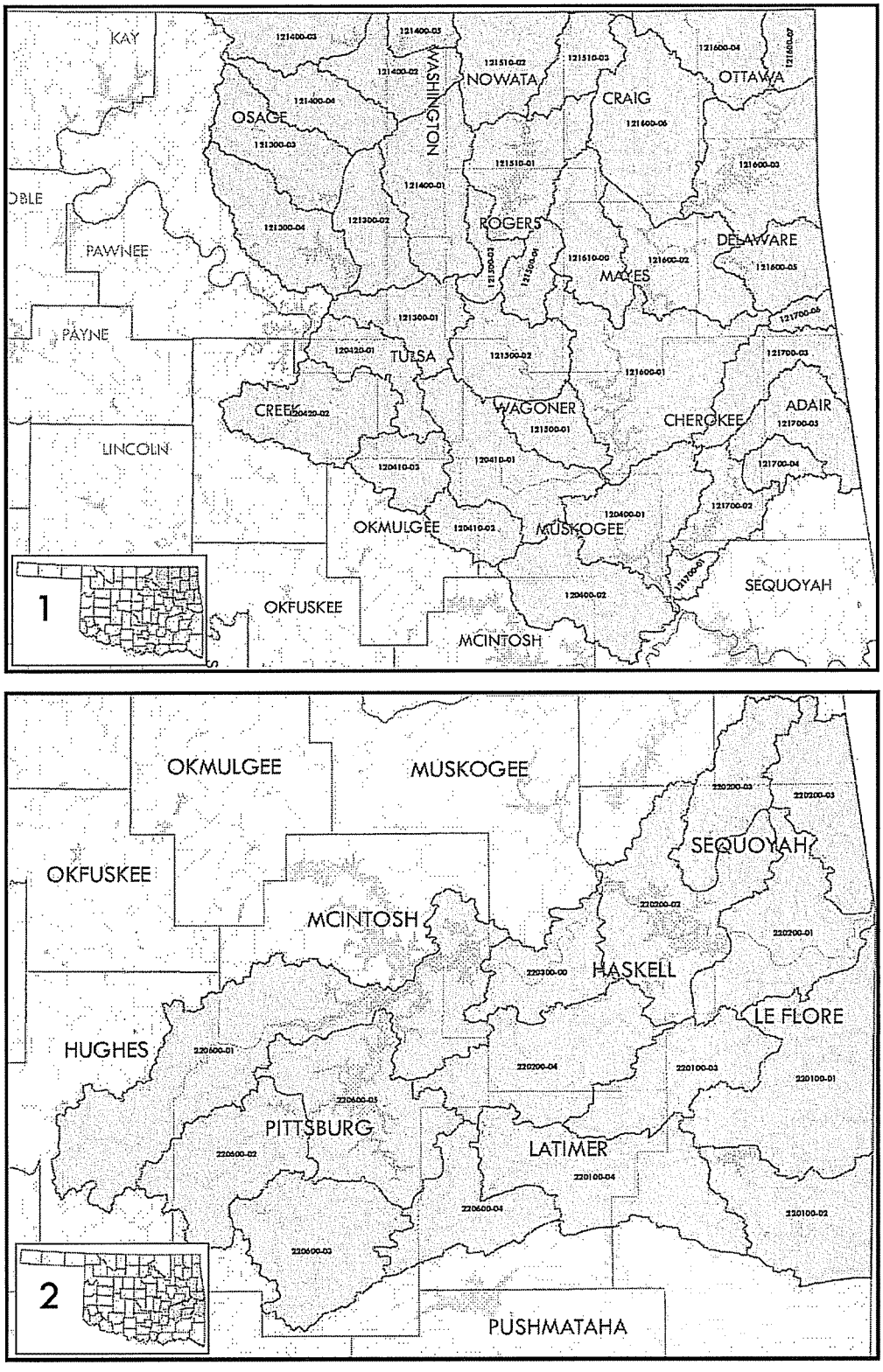
Figure 3. WBID Numbers

The next four digits of a WBID number were originally intended to represent a hydrologic sequence of waterbodies, going from the most downstream point in the eight-digit watershed up to the furthest upstream point in the watershed. These four digits were originally selected by tens (e.g., 0010, 0020, 0030). This provided for the addition of waterbodies while maintaining the hydrologic sequence as much as possible. Not all waterbodies have been assigned an identification number, primarily due to limited resources and need. As more waterbodies are assessed, the WBID system is designed to incorporate a unique identifier for these waterbodies (Figure 3).

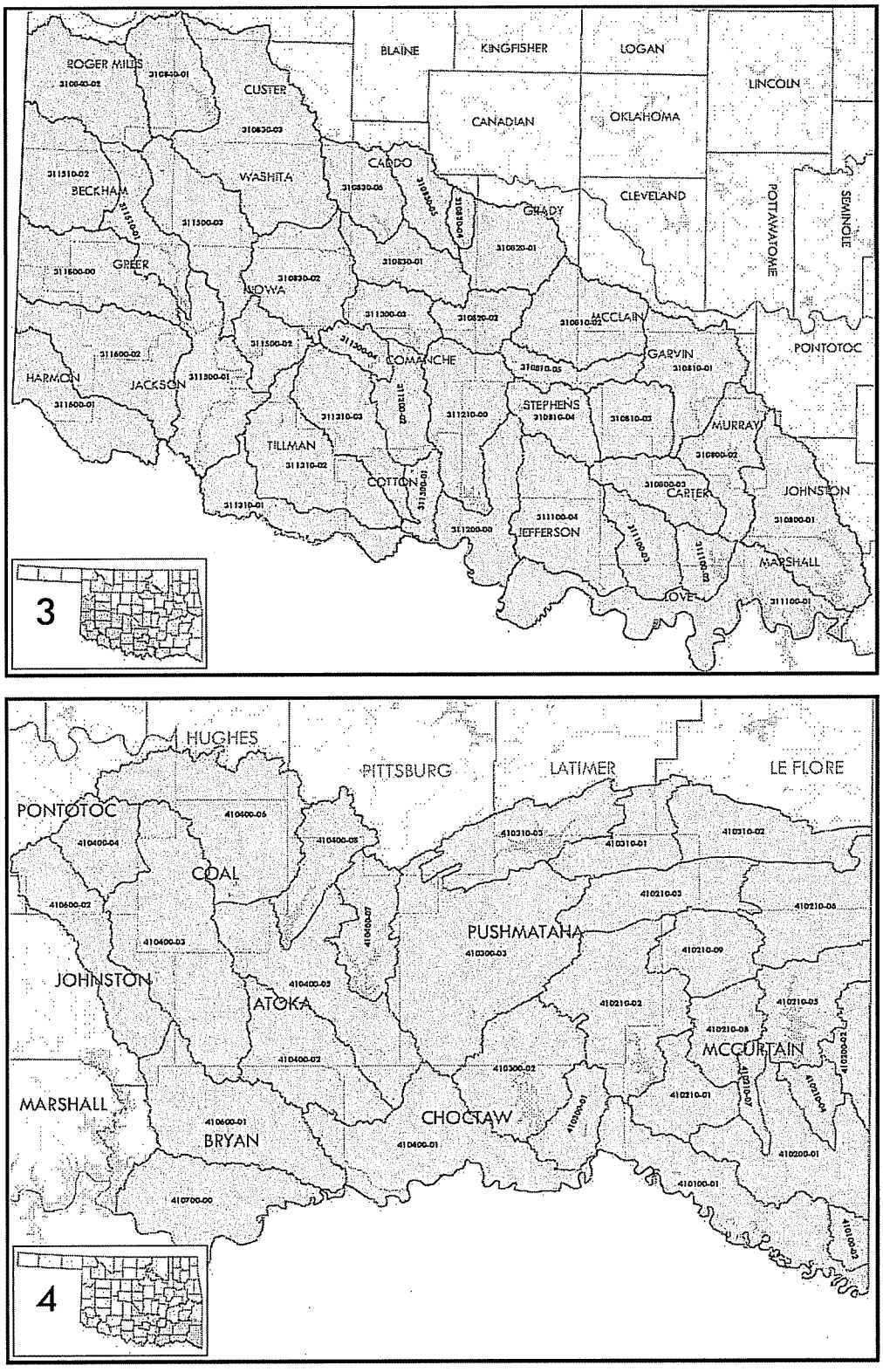


Elk Creek
"OK 311500 03 0010_00"

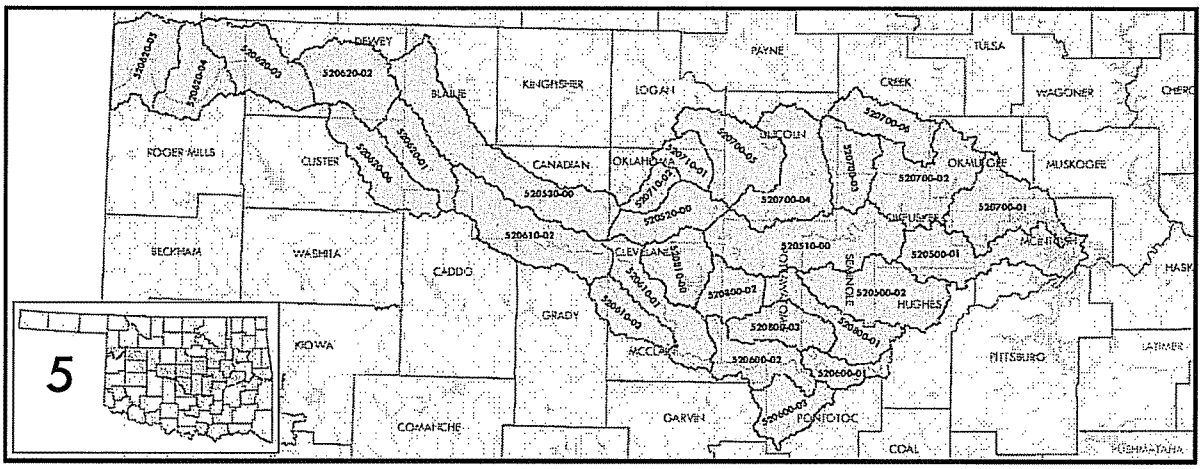
The last two digits of a WBID number allow a waterbody to be segmented further in order to identify specific portions. Waterbody segments are identified by a segment ID made up of an underscore and two additional digits. Waterbodies are initially assigned a segment ID of _00. If additional segmentation is required, upstream segments receive a number higher in value (e.g., _10, _20, _30).

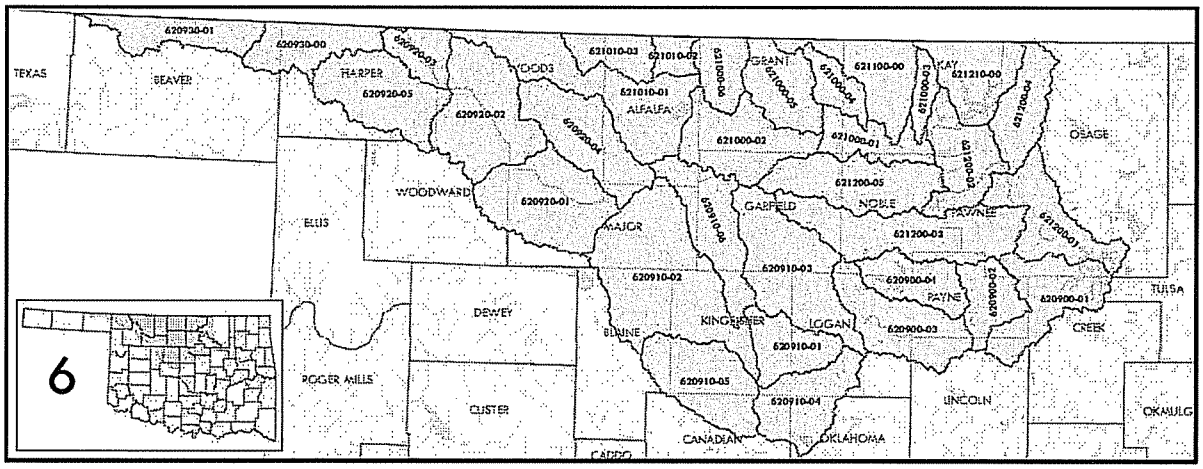


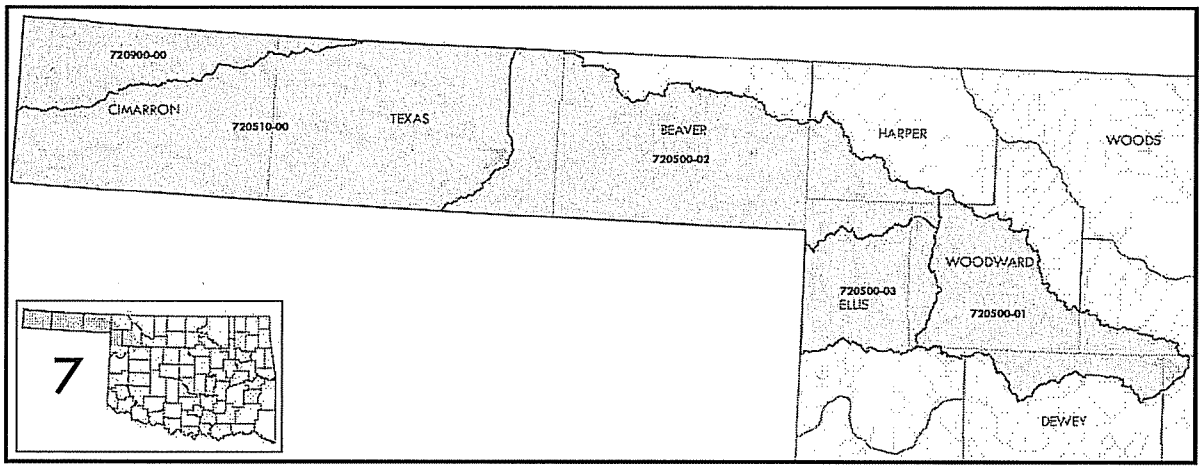
Oklahoma 8-digit Planning Basins 1 and 2



Oklahoma 8-digit Planning Basins 3 and 4







Oklahoma 8-digit Planning Basins 5, 6, and 7

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Appendix C

2008 Oklahoma 303(d) List of Impaired Waters

Waterbody ID	Waterbody Name	Waterbody Size	Category	TMDL Date
OK120400010070_00*	**Webbers Falls Lake**	**11,600.00 ACRES**	**5a**	**2016** NEW
Cause of Impairment	Impaired Use	Potential Sources		
Enterococcus*	***Primary Body Contact Recreation***	***46, 108, 136, 140***		
OK120400010130_00	**Greenleaf Lake**	**920.00 ACRES**	**5a**	**2013**
Cause of Impairment	Impaired Use	Potential Sources		
Chlorophyll-a*	***Public and Private Water Supply***	***140***		
Oxygen, Dissolved	FWP - Warm Water Aquatic Community	140		
Turbidity	FWP - Warm Water Aquatic Community	140		
OK120400010260_00	**Arkansas River**	**11.17 MILES**	**5a**	**2013**
Cause of Impairment	Impaired Use	Potential Sources		
Cadmium	FWP - Warm Water Aquatic Community	34, 62, 85, 140		
Chloride*	***Agriculture***	***49, 102, 140***		
Enterococcus	Primary Body Contact Recreation	34, 108, 133, 136, 140		
Lead	FWP - Warm Water Aquatic Community	34, 62, 85, 140		
Lead	Fish Consumption	34, 62, 85, 140		
Total Dissolved Solids*	***Agriculture***	***49, 102, 140***		
OK120400010400_00	**Coody Creek**	**16.16 MILES**	**5a**	**2013**
Cause of Impairment	Impaired Use	Potential Sources		
Enterococcus*	***Primary Body Contact Recreation***	***46, 59, 92, 108, 111, 133, 136, 140***		
Oxygen, Dissolved	FWP - Warm Water Aquatic Community	46, 59, 87, 92, 108, 111, 133, 136, 140		
OK120400020010_00	**Dirty Creek**	**44.18 MILES**	**5a**	**2016**
Cause of Impairment	Impaired Use	Potential Sources		
Turbidity	FWP - Warm Water Aquatic Community	21, 46, 49, 87, 108, 140		
Oxygen, Dissolved	FWP - Warm Water Aquatic Community	46, 87, 92, 108, 136, 140		
OK120400020030_00	**Dirty Creek, South Fork**	**15.55 MILES**	**5a**	**2019**
Cause of Impairment	Impaired Use	Potential Sources		
Enterococcus*	***Primary Body Contact Recreation***	***4, 46, 59, 92, 108, 111, 133, 136, 140***		
Oxygen, Dissolved	FWP - Warm Water Aquatic Community	46, 85, 87, 92, 108, 111, 133, 136, 140		
OK120400020110_00	**Dirty Creek, Georges Fork**	**10.05 MILES**	**5a**	**2016**
Cause of Impairment	Impaired Use	Potential Sources		
Enterococcus*	***Primary Body Contact Recreation***	***46, 92, 108, 111, 133, 136, 140***		
Oxygen, Dissolved	FWP - Warm Water Aquatic Community	46, 87, 92, 108, 111, 133, 136, 140		
OK120400020160_00	**Butler Creek**	**10.34 MILES**	**5a**	**2019**
Cause of Impairment	Impaired Use	Potential Sources		
Enterococcus*	***Primary Body Contact Recreation***	***46, 59, 92, 108, 111, 133, 136, 140***		
Oxygen, Dissolved	FWP - Warm Water Aquatic Community	46, 59, 87, 92, 108, 111, 133, 136, 140		

Cause Name* - Indicates new cause listing for 2008

Waterbody ID* & NEW - Indicate new waterbody listing for 2008

Waterbody ID	Waterbody Name	Waterbody Size	Category	TMDL Date
OK121600070010_00	**Spring River**	**22.11 MILES**	**5a**	**2016**
Cause of Impairment	Impaired Use	Potential Sources		
Zinc	FWP - Cool Water Aquatic Community	82, 140		
Turbidity	FWP - Cool Water Aquatic Community	46, 108, 140		
Enterococcus	Primary Body Contact Recreation	4, 46, 59, 108, 133, 136, 140		
Lead*	***Fish Consumption***	***49, 85, 140***		
Lead*	***FWP - Cool Water Aquatic Community***	***49, 85, 140***		
OK121610000050_10	**Pryor Creek**	**4.97 MILES**	**5a**	**2016**
Cause of Impairment	Impaired Use	Potential Sources		
Enterococcus	Primary Body Contact Recreation	46, 68, 85, 92, 108, 111, 128, 133, 136, 140		
Escherichia coli*	***Primary Body Contact Recreation***	***46, 68, 92, 108, 111, 128, 133, 136, 140***		
Oxygen, Dissolved	FWP - Warm Water Aquatic Community	46, 85, 87, 92, 108, 111, 128, 133, 136, 140		
Total Dissolved Solids*	***Agriculture***	***49, 102, 140***		
OK121610000090_00	**Pryor Creek**	**2.35 MILES**	**5a**	**2019**
Cause of Impairment	Impaired Use	Potential Sources		
Turbidity	FWP - Warm Water Aquatic Community	156, 140		
Escherichia coli	Primary Body Contact Recreation	84, 85, 92, 156, 140		
Oxygen, Dissolved	FWP - Warm Water Aquatic Community	84, 85, 92, 156, 140		
OK121700020020_00	**Tenkiller Ferry Lake**	**8,440.00 ACRES**	**5a**	**2010**
Cause of Impairment	Impaired Use	Potential Sources		
Phosphorus (Total)	Aesthetic	140		
Chlorophyll-a*	***Public and Private Water Supply***	***4, 59, 108, 136, 146, 140***		
Oxygen, Dissolved	FWP - Warm Water Aquatic Community	140		
OK121700020110_00	**Chicken Creek**	**3.54 MILES**	**5a**	**2010**
Cause of Impairment	Impaired Use	Potential Sources		
Fishes Bioassessments	FWP - Warm Water Aquatic Community	140		
OK121700020220_00	**Tenkiller Ferry Lake, Illinois River Arm**	**5,030.00 ACRES**	**5a**	**2010**
Cause of Impairment	Impaired Use	Potential Sources		
Oxygen, Dissolved	FWP - Warm Water Aquatic Community	4, 46, 59, 92, 108, 136, 146, 140		
OK121700030010_00	**Illinois River**	**7.68 MILES**	**5a**	**2010**
Cause of Impairment	Impaired Use	Potential Sources		
Enterococcus	Primary Body Contact Recreation	4, 59, 85, 108, 136, 146, 140		
Phosphorus (Total)	Aesthetic	4, 46, 59, 85, 92, 100, 108, 146, 140		
OK121700030040_00	**Tahlequah Creek (Town Branch)**	**6.21 MILES**	**5a**	**2010**
Cause of Impairment	Impaired Use	Potential Sources		
Escherichia coli	Primary Body Contact Recreation	46, 92, 108, 133, 136, 140		

Cause Name* - Indicates new cause listing for 2008

Waterbody ID* & NEW - Indicate new waterbody listing for 2008

Waterbody ID	Waterbody Name	Waterbody Size	Category	TMDL Date
OK121700030080_00	Illinois River	31.68 MILES	5a	2010
Cause of Impairment	Impaired Use	Potential Sources		
Phosphorus (Total)	Aesthetic	4, 46, 59, 108, 133, 136, 146, 140		
Lead*	***FWP - Cool Water Aquatic Community***	***140***		
Escherichia coli	Primary Body Contact Recreation	4, 46, 59, 92, 108, 133, 136, 146, 140		
Fecal Coliform	Primary Body Contact Recreation	4, 46, 59, 92, 108, 133, 136, 146, 140		
OK121700030280_00	Illinois River	15.65 MILES	5a	2010
Cause of Impairment	Impaired Use	Potential Sources		
Phosphorus (Total)	Aesthetic	4, 46, 59, 92, 108, 133, 136, 146, 140		
OK121700030290_00	Flint Creek	1.60 MILES	5a	2010
Cause of Impairment	Impaired Use	Potential Sources		
Oxygen, Dissolved	FWP - Cool Water Aquatic Community	4, 46, 59, 92, 108, 133, 136, 146, 140		
Phosphorus (Total)*	***Aesthetic***	***4, 46, 59, 92, 108, 133, 136, 146, 140***		
OK121700030350_00	Illinois River	5.18 MILES	5a	2013
Cause of Impairment	Impaired Use	Potential Sources		
Enterococcus	Primary Body Contact Recreation	4, 46, 59, 92, 100, 108, 133, 136, 146, 140		
Phosphorus (Total)	Aesthetic	4, 34, 46, 59, 92, 100, 133, 136, 146, 140		
Turbidity	FWP - Cool Water Aquatic Community	46, 59, 85, 108, 146, 140		
OK121700030370_00*	Ballard Creek	12.60 MILES	5a	2013 NEW
Cause of Impairment	Impaired Use	Potential Sources		
Enterococcus*	***Primary Body Contact Recreation***	***4, 46, 59, 92, 108, 111, 133, 136, 140***		
OK121700040010_00*	Caney Creek	20.92 MILES	5a	2016 NEW
Cause of Impairment	Impaired Use	Potential Sources		
Enterococcus*	***Primary Body Contact Recreation***	***4, 46, 59, 62, 85, 92, 108, 133, 136, 140***		
OK121700050010_00	Illinois River, Baron Fork	23.30 MILES	5a	2013
Cause of Impairment	Impaired Use	Potential Sources		
Enterococcus	Primary Body Contact Recreation	4, 46, 59, 92, 108, 133, 136, 146, 140		
Phosphorus (Total)	Aesthetic	4, 46, 59, 92, 108, 133, 136, 146, 140		
OK121700050090_00	Tyner Creek	14.89 MILES	5a	2013
Cause of Impairment	Impaired Use	Potential Sources		
Enterococcus	Primary Body Contact Recreation	4, 46, 59, 92, 108, 136, 140		
OK121700050120_00	Peacheater Creek	10.28 MILES	5a	2013
Cause of Impairment	Impaired Use	Potential Sources		
Enterococcus	Primary Body Contact Recreation	4, 46, 59, 92, 100, 108, 128, 136, 140		
OK121700060010_00	Flint Creek	7.75 MILES	5a	2010
Cause of Impairment	Impaired Use	Potential Sources		
Enterococcus	Primary Body Contact Recreation	4, 46, 59, 92, 100, 108, 111, 133, 136, 146, 140		
Phosphorus (Total)	Aesthetic	4, 59, 146, 140		

Cause Name* - Indicates new cause listing for 2008

Waterbody ID* & NEW - Indicate new waterbody listing for 2008